I – Problem Statement Title (GS 035)

Live Load Distribution to Integral Bent Caps in Framed Box Girders

II – Research Problem Description

Question: How can we reduce project delivery time through standardization of national specifications that don't address California-type transportation structures?

Distribution of vehicular live load reactions to bent caps is not addressed in the *AASHTO LRFD Specifications*. Conservatively, wheel line loads are applied to the bent cap in line with the transverse position of the truck. The support reactions from longitudinal analysis are used to design the bent cap—regardless of the controlling truck position along the span. This method of distributing live loads to bent caps does not consider the fact that most of the lane loading transfers to and through the girders to the bent cap. The stiffness added to an integral cap by the girders is also not considered.

With the adoption of *LRFD*, Caltrans will design for a new permit vehicle that is heavier than that in use for Bridge Design in California since 1983. Bent cap dimensions and structure cost are likely to increase--especially in longer span bridges, if the conservative method described above is used. Excessive amounts of mild reinforcement for shear and in the top of integral bent caps where post-tensioning ducts pass through, may lead to constructability issues. Yet, bent caps have been performing satisfactorily; an increase in geometry doesn't seem warranted. A more refined analysis can be done to verify adequate load distribution; however, such procedures are time-consuming.

III – Objective

STAP Roadmap Outcome: 9. Nationally accepted Specifications will be advanced for implementation in California…by carrying out the following tasks:

- Perform three-dimensional analysis and parameter studies to determine the actual distribution of wheel line loads to bent caps for both short and long span bridges, integral and non-integral bent caps. The analysis should be based on LRFD and should include both HL-93 and the new P-15 loads.
- Determine the difference in demands placed on bent caps based on the 3D analysis compared with current practice
- Recommend a simple, more accurate LL distribution to integral and non-integral bent caps. A percentage of girder web participation in integral bent cap resistance could be recommended in lieu of LL distribution, if properly substantiated.

IV – Background

The *AASHTO LRFD Specifications* have become more sophisticated in evaluating load distribution to longitudinal members, while no similar enhancement has been made in load distribution to bent caps. The *LRFD Specs'* authors tended to focus on beam-slab bridges with drop-caps, as framed structures do not comprise a majority of bridges nationwide.

V -Statement of Urgency, Benefits, and Expected Return on Investment

Needed to comply with FHWA mandate to be using the *AASHTO LRFD Bridge Design Specifications* on all new bridges by Oct. 2007, or lose ~20% of federal funding.

VI – Related Research

VII - Deployment Potential

Deployable product will be a California Amendment to Section 4 of the *AASHTO LRFD Specifications*, and/or a new *Bridge Design Aid*, both to be generated by the DES Bridge Loads Committee.